

U.S. DEPARTMENT OF  
**ENERGY**

Office of  
**ENERGY EFFICIENCY &  
RENEWABLE ENERGY**

# Geothermal Technologies Office

## Stanford Geothermal Workshop 2021



Dr. Susan Hamm, Director

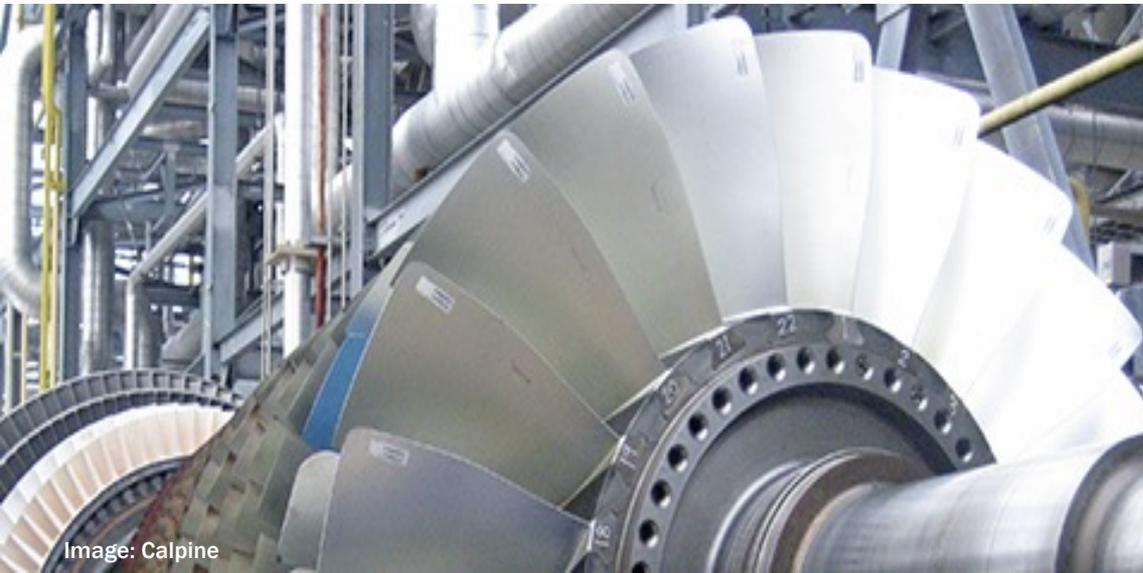


Image: Calpine



# Biden-Harris Administration Priorities

Key elements of the *Biden Plan to Build a Modern, Sustainable Infrastructure and an Equitable Clean Energy Future* include:

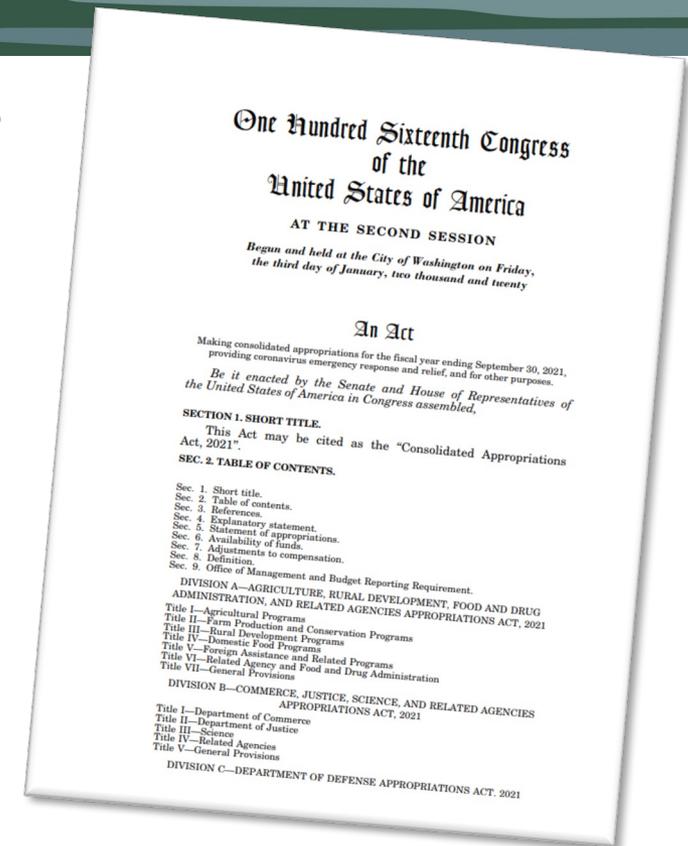
- Build a modern infrastructure.
- Position the U.S. auto industry to win the 21st Century with technology invented in America.
- Achieve a carbon pollution-free power sector by 2035.
- Make dramatic investments in energy efficiency in buildings, including completion of 4 million retrofits and 1.5 new affordable homes.
- Pursue an historic investment in clean energy innovation.
- Advance sustainable agriculture and conservation.
- Secure environmental justice and equitable economic opportunity.

# H.R. 133 – Consolidated Appropriations Act, 2021

## Section 3002: Advanced Geothermal Innovation Leadership

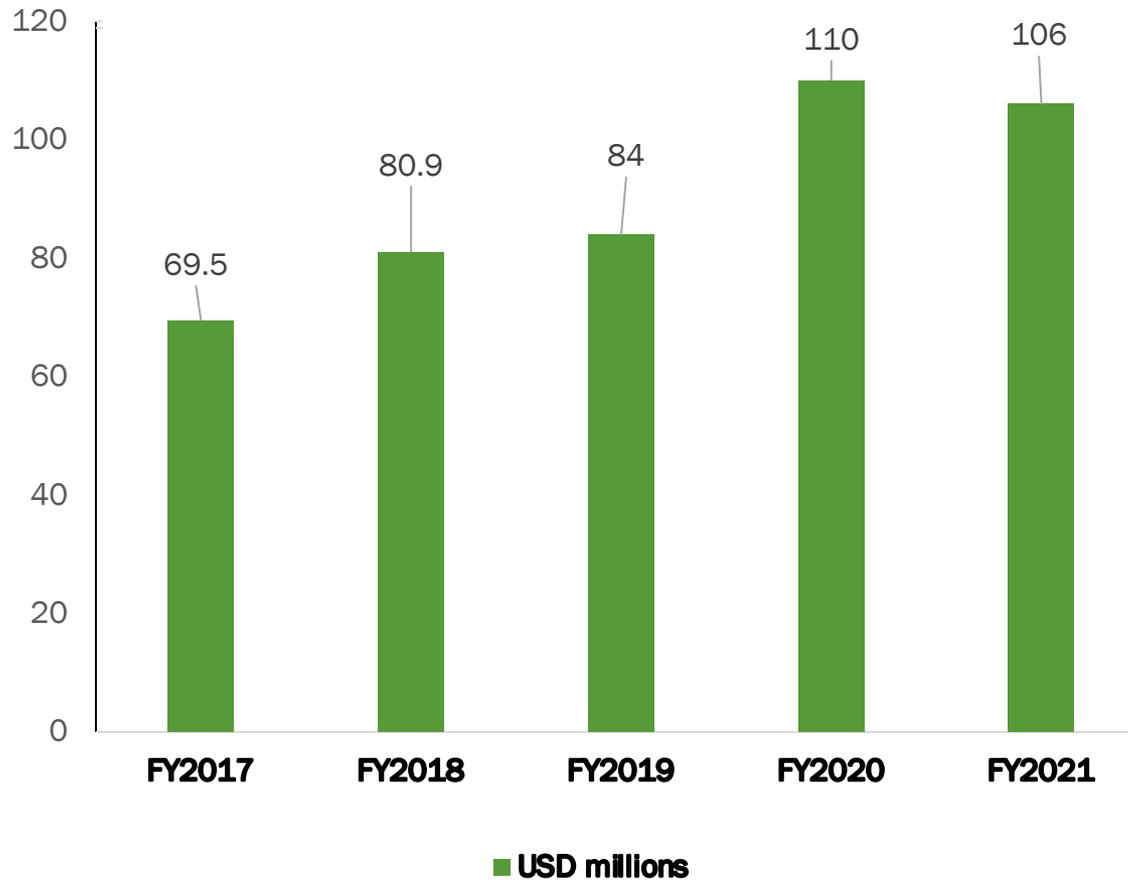
### Authorizes:

- R&D for exploration technologies
- Demonstration of exploratory drilling technologies
- Reservoir Thermal Energy Storage
- Oil and Gas Technology Transfer Initiative
- Critical materials R&D
- Flexible operations of geothermal power plants
- Integrated Energy Systems
- Drilling Data Repository
- Three (3) FORGE sites
- EGS demonstrations
- GHP R&D
- Direct Use R&D
- Education & outreach
- Technical assistance
- Advanced computing and machine learning
- International partnerships
- Update to geothermal resource assessments
- Etc...



# GTO Budget Overview

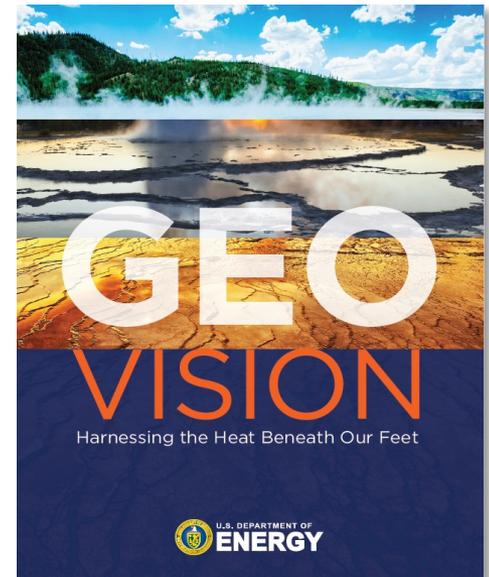
## GTO Appropriations (Past 5 Years)



## Top Priorities

GTO's top priority for the next 8-10 years is to demonstrate geothermal energy's value as the **dispatchable baseload renewable of the future** for the U.S. To do this, we will support R&D to:

- 1) Unlock the potential of enhanced geothermal systems:** Ensure that engineered reservoirs – created where there is hot rock but little to no natural permeability or fluid saturation present in the subsurface – become commercially viable.
- 2) Increase geothermal energy on the U.S. electricity grid:** Reduce risks and costs of all aspects of geothermal energy, including exploration, drilling, and deployment, to make geothermal energy an ever-more attractive piece of the energy portfolio.
- 3) Expand geothermal energy opportunities throughout the United States:** Increase deployable technology and awareness of Deep-EGS, geothermal heat pumps, district heating, and thermal energy storage across the entire country.



# Highlight: Utah FORGE Drilling



Photo: Eric Larson

## The latest news at Utah FORGE

- Directional drilling completed for the first of two planned injection/production wells – measured depth 11,000 feet completed in half the time expected.
- Monitoring well at 9,000 feet is currently being drilled.
- Site characterization and modeling is ongoing in support of stimulation later this year.
- Coming soon: Selections announcement for \$46M FORGE R&D solicitation.

# Highlight: EGS Collab

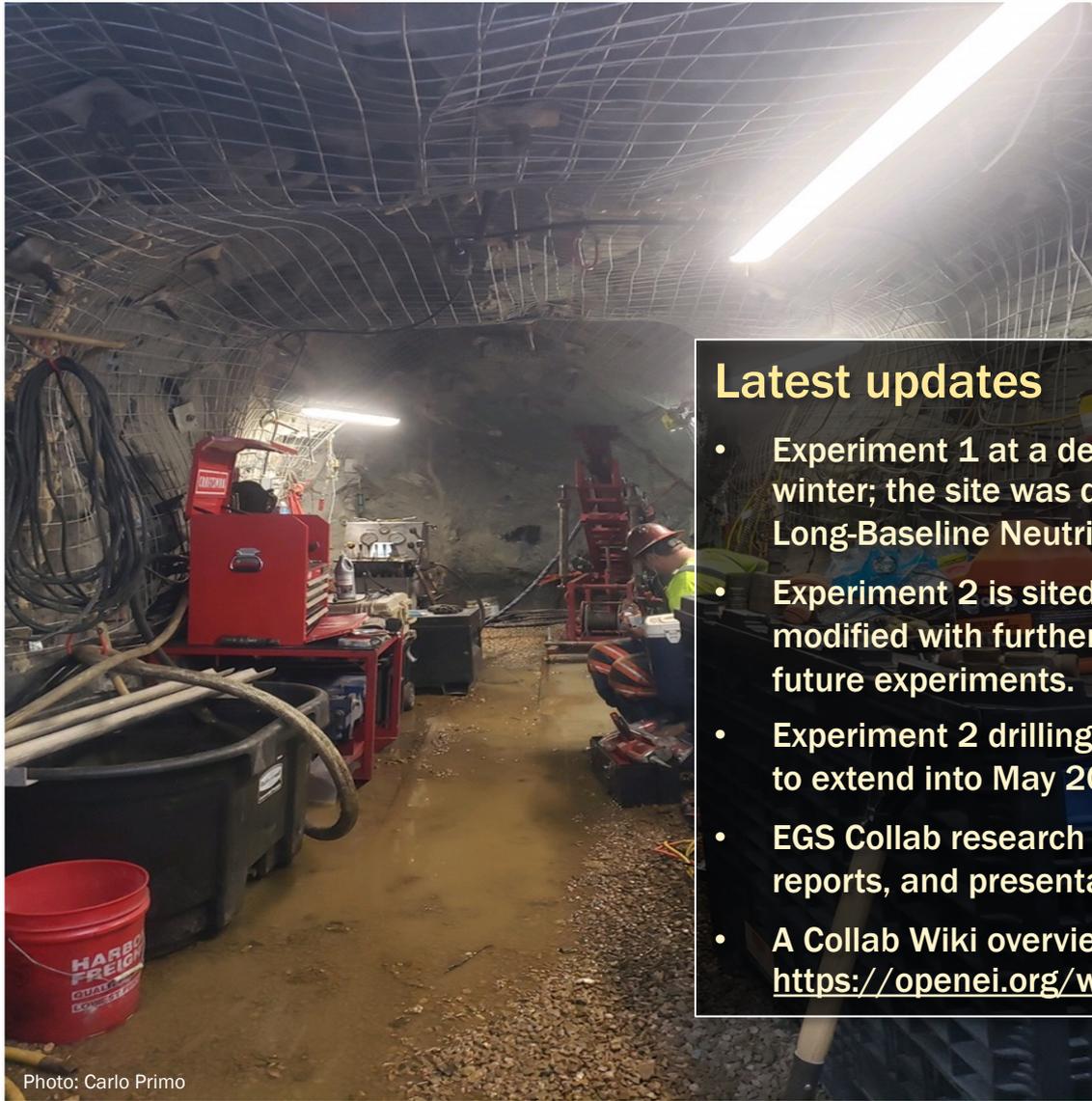


Photo: Carlo Primo



## Latest updates

- Experiment 1 at a depth of 4,850 feet was completed last winter; the site was decommissioned to make way for the Long-Baseline Neutrino Facility.
- Experiment 2 is sited at the 4,100-foot level and has been modified with further excavation to accommodate possible future experiments.
- Experiment 2 drilling is underway (shown left) and is expected to extend into May 2021.
- EGS Collab research has resulted in more than 120 papers, reports, and presentations to date, with more to come.
- A Collab Wiki overview has been developed: [https://openei.org/wiki/EGS\\_Collab\\_Project\\_Overview](https://openei.org/wiki/EGS_Collab_Project_Overview)

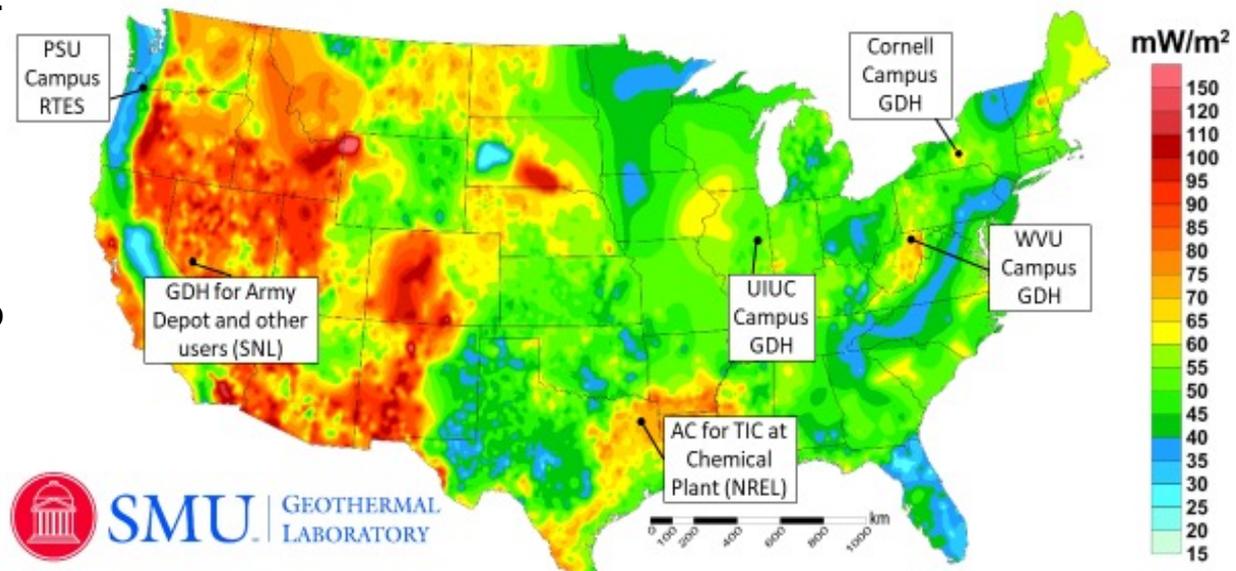
# Highlight: Deep Direct-Use: Feasibility Studies

Feasibility parameters included well flow rates, utilization rates, taxes and incentives, and exploration and capital costs.

The DDU studies provided information on costs and other attributes that can help end users and developers assess future projects across a range of different climates and regions.

## DDU Case Study Locations

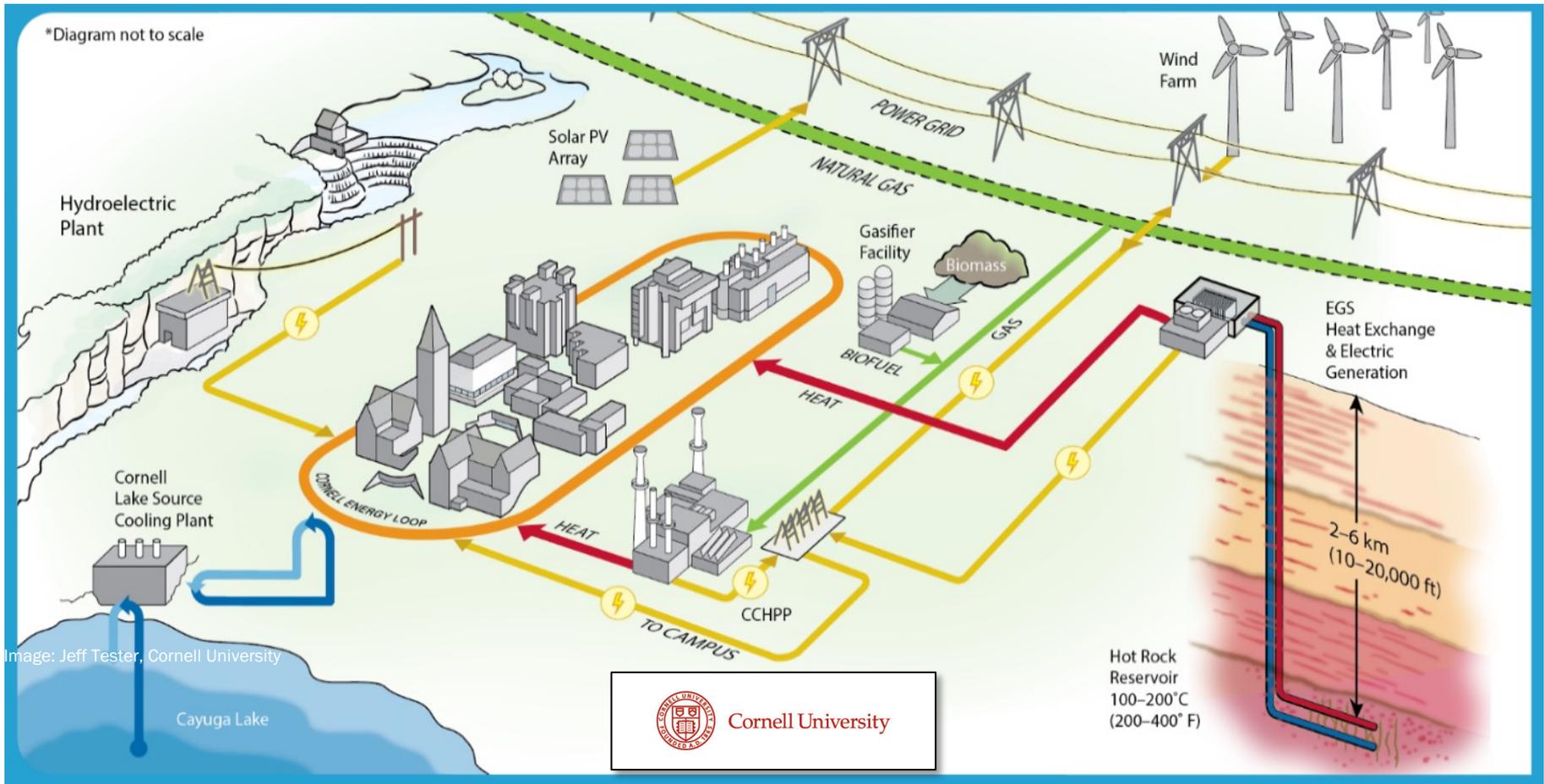
For DDU-related publications, go to <https://gdr.openet.org> and search "DDU"



### Acronyms

GDH = Geothermal District Heating  
RTES = Reservoir Thermal Energy Storage  
AC = Absorption Chilling  
TIC = Turbine Inlet Cooling

# Deep Direct-Use: Cornell Earth Source Heat



# Drilling Innovation: University of Texas at Austin

The Geothermal Entrepreneurship Organization (GEO) at the University of Texas-Austin serves in a valuable incubator role for emerging geothermal innovators.

Its first incubated company, **Sage Geosystems**, is led by a team of oil and gas veterans working to pivot the hydrocarbons industry toward geothermal.

Sage has secured \$3M in Series A funding from Virya LLC, a climate fund founded by TED curator Chris Anderson.

Sage's Phase I demonstration well in Texas is scheduled for drilling this year.

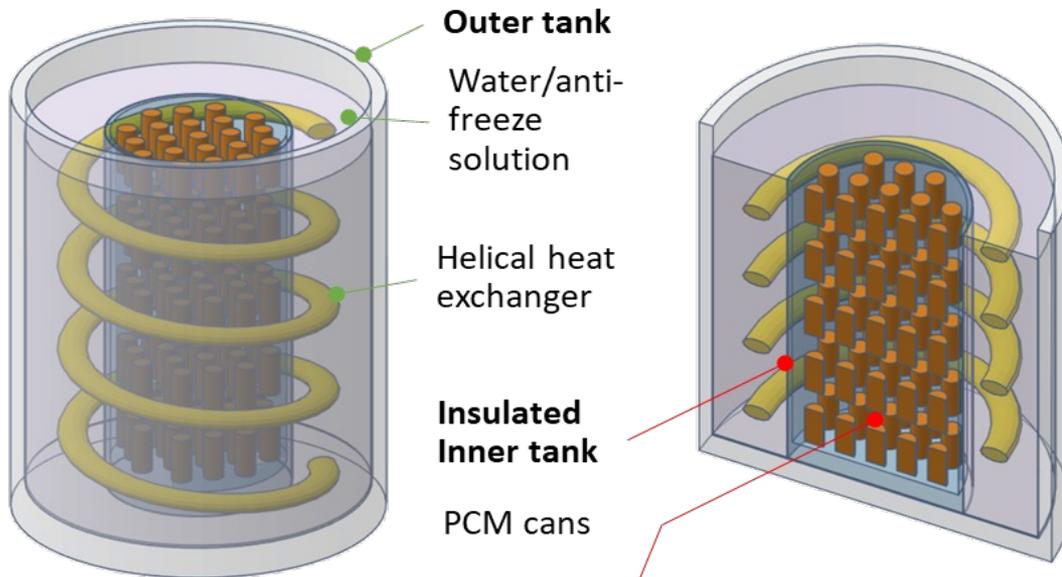


[texasgeo.org](http://texasgeo.org)



[sagegeo.com](http://sagegeo.com)

# Highlight: Thermal Energy Storage / ORNL



**Patent Pending**

(KS Ref. No. 8490-103882-01)

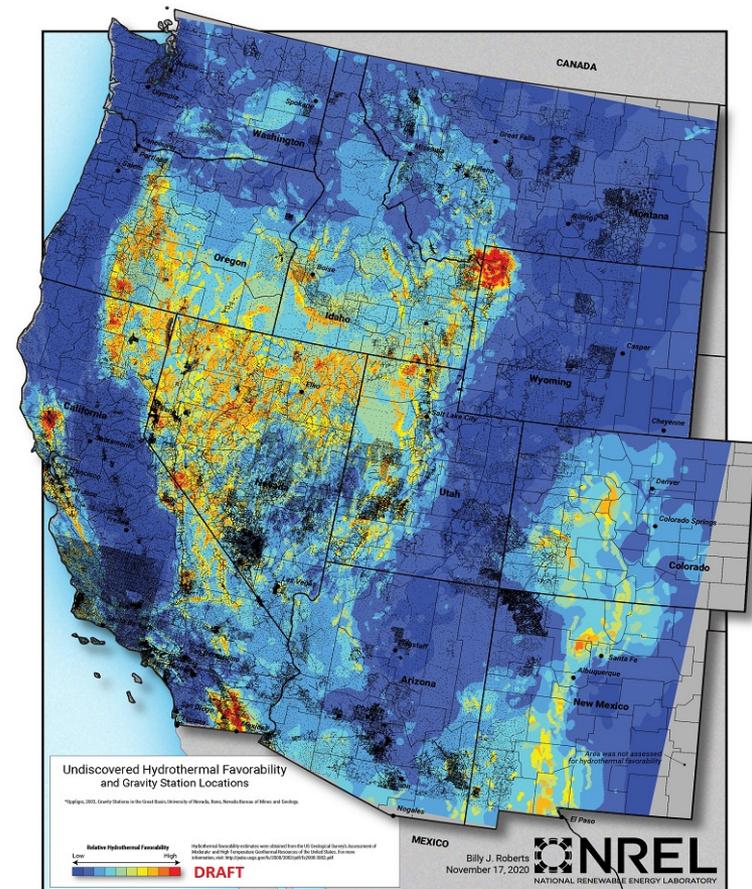
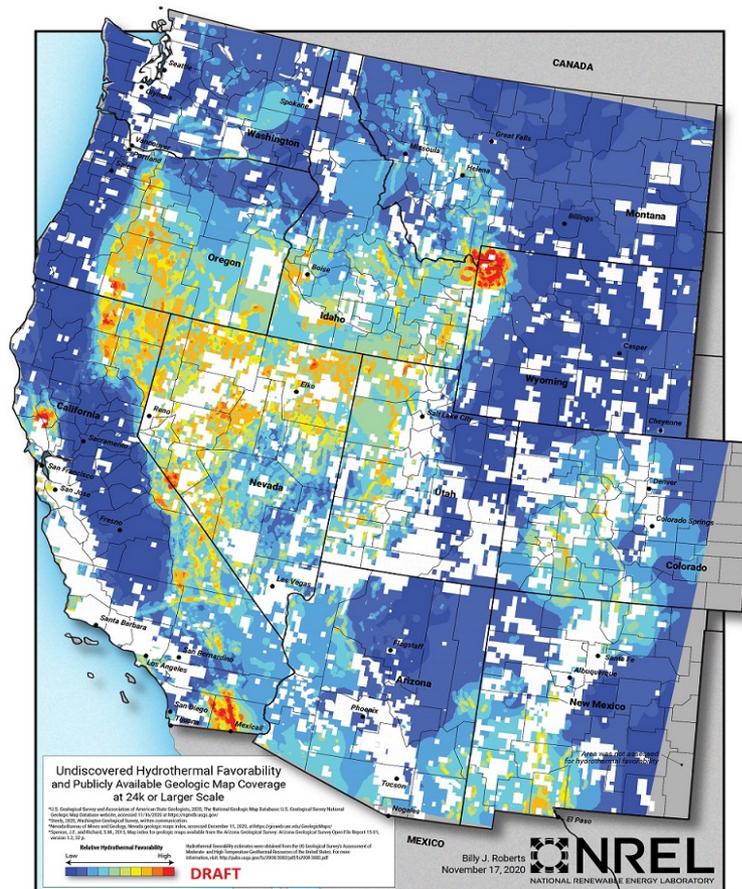


PCM filled in small cans

- ORNL has designed a Dual-Purpose Underground Thermal Battery (DPUTB).
- The DPUTB is a core component of a novel building thermal system that integrates a dual-source heat pump with the DPUTB.
- Aggregating the DPUTB at a large scale could prove a valuable ancillary resource to electricity grid operations.

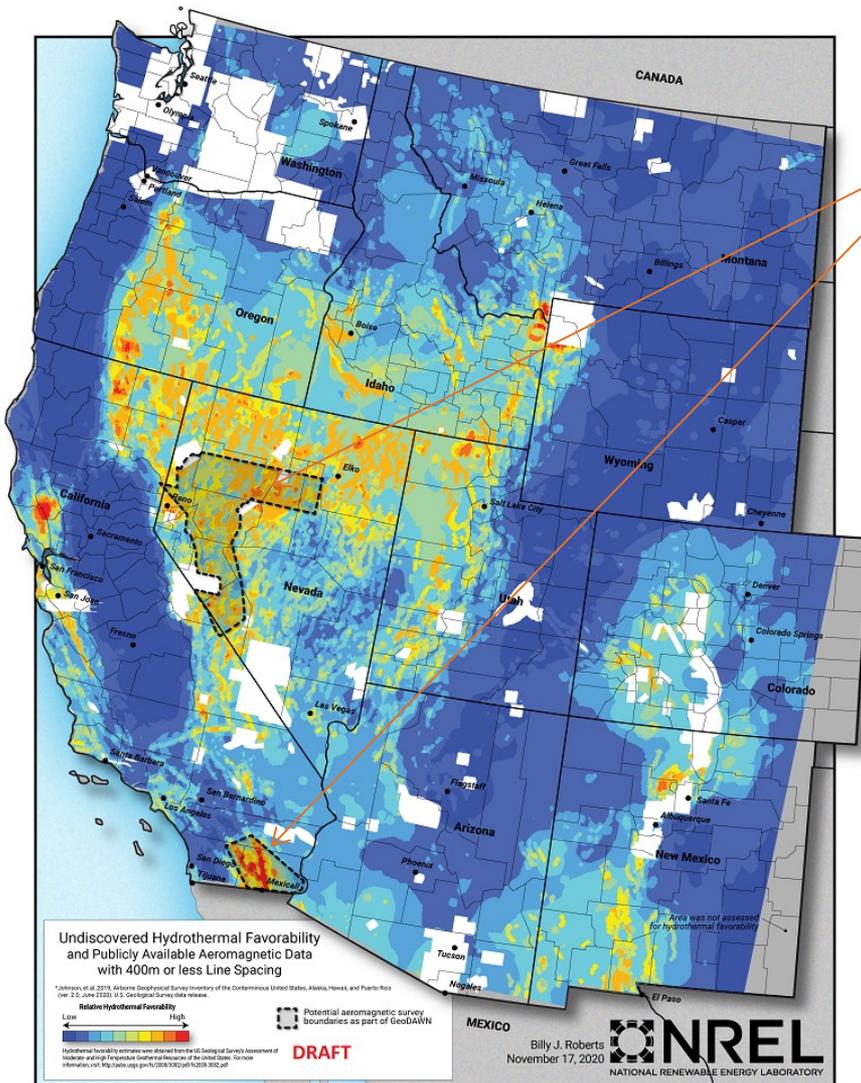
*The inner tank (above right) provides short-term thermal energy storage, while the outer tank works as a low-cost shallow-bore ground heat exchanger. The unit delivers no net heat loss and, as a subsurface component, occupies no floor or roof space.*

# Highlight: Play Fairway Analysis >> Geoscience Data Acquisition for Western Nevada (GeoDAWN)



Completion of data-gap analyses validates key data inputs for PFA and identifies prospective (undiscovered hydrothermal) regions for gathering additional data. Shown above are assessments conducted for geologic map coverage (left) and gravity station locations (right).

# Geoscience Data Acquisition for Western Nevada (GeoDAWN)



Shown left is a map depicting favorable areas that still lack publicly available aeromagnetic data. The shaded areas indicate regions of ongoing or planned data acquisition to be carried out in partnership with the USGS.



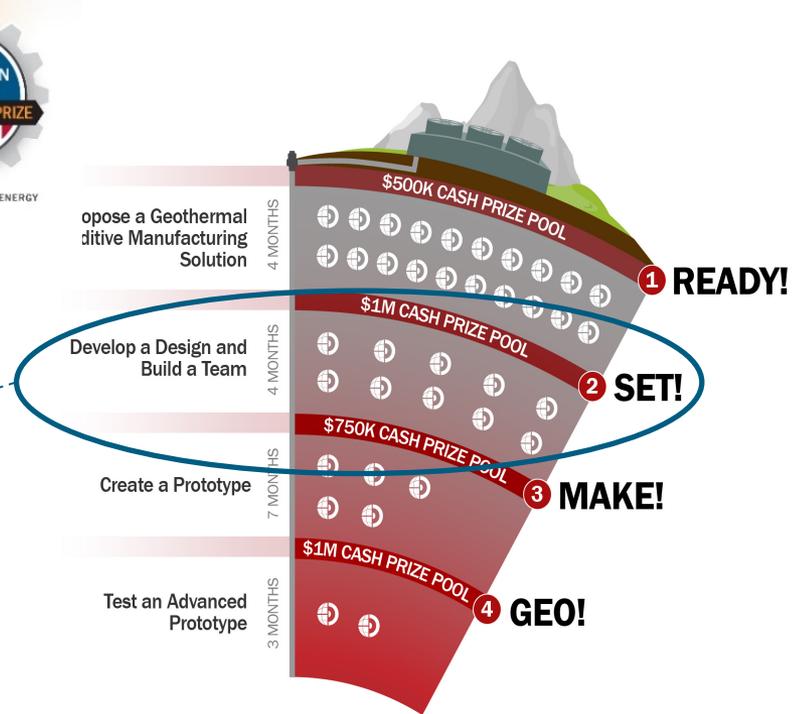
Walker Lane (above) is a geologic trough that aligns with the border between California and Nevada. Its subsurface characteristics are of particular interest to GTO and USGS researchers.

# Geothermal Manufacturing Prize



Fifteen first stage (**Ready!**) winners were chosen last fall and announced at the annual Geothermal Rising conference.

The second stage (**Set!**) is ongoing until February 17, with \$1.75M in cash and vouchers available. Up to 10 winners will be announced in April.



## Geothermal Energy R&D: An Overview of the U.S. Department of Energy's Geothermal Technologies Office

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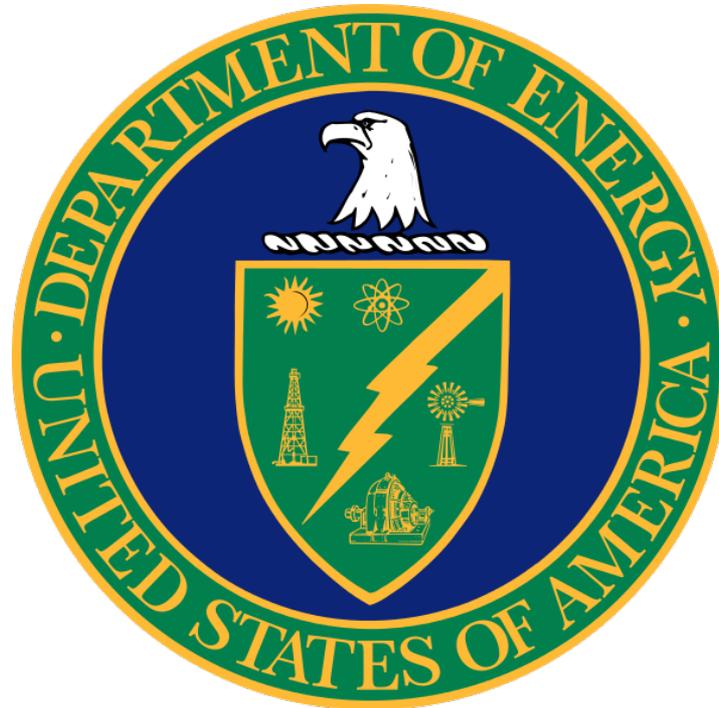
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### ABSTRACT

Geothermal energy can provide answers to many of America's essential energy questions. The United States has tremendous geothermal resources, as illustrated by the results of the DOE GeoVision analysis, but technical and non-technical barriers have historically stood in the way of widespread deployment of geothermal energy. The U.S. Department of Energy's Geothermal Technologies Office within the Office of Energy Efficiency and Renewable Energy has invested more than \$470 million in research and development (R&D) since 2015 to meet its three strategic goals: (1) unlock the potential of enhanced geothermal systems, (2) advance technologies to increase geothermal energy on the U.S. electricity grid, and (3) support R&D to expand geothermal energy opportunities throughout the United States. This paper describes many of those R&D initiatives and outlines future directions in geothermal research.

GTO-authored paper in the *Journal of Energy Resources Technology* (ASME)

# What's Next for GTO?



# Thank You!

- Interested in serving as a merit reviewer?
- Questions or comments?

Contact us: [doe.geothermal@ee.doe.gov](mailto:doe.geothermal@ee.doe.gov)

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[www.energy.gov/geovision](http://www.energy.gov/geovision)

